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Alberta
GOVERNMENT OF ALBERTA

Front Cover: Aerial photograph of experimental plots on the Alberta Environmental Centre site in Vegreville.

ALBERTA ENVIRONMENTAL CENTRE
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1984-85

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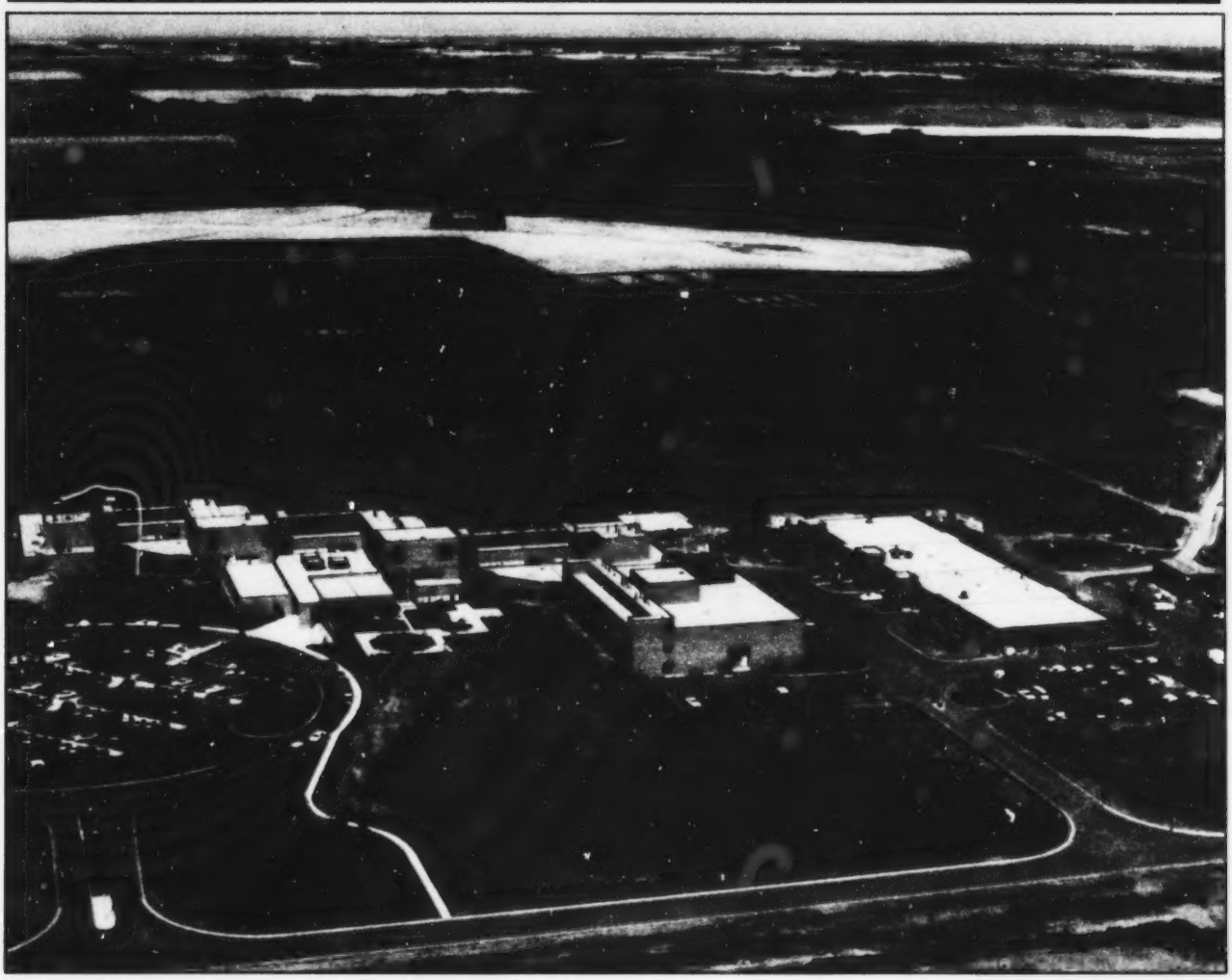
INTRODUCTION



The Centre's land and buildings are located on the western side of Vegreville.

The 1984-85 fiscal year marked the completion of approximately five years since the first staff moved into the Alberta Environmental Centre in Vegreville. Accordingly, this Annual Review notes some highlights of those years while considering in more detail the Centre's activities in the 12 months ended March 31, 1985.

Planning the work at the Centre was undertaken in close co-operation with the Alberta Government departments and agencies which requested the studies. This process, facilitated and approved by a Board of Directors and a Technical Advisory Committee, led to the broad range of activities now undertaken in nine Program Areas, over 45 Programs and 120 Projects.

The 16,700 square-metre main laboratory, on a 750-acre (300-hectare) site, was first occupied in late 1979, and progressively developed since then.

In the past five years, facilities requiring an investment of over $40 million were developed, a multi-disciplinary staff with advanced training in many fields was hired and major programs of environmental services, research and technical development were planned and carried out.

The thrust of Centre activity encompassed a wide variety of work, such as: integrated pest management; the chemistry of municipal water supplies and sewage treatment systems; analytical and scientific support for environmental licensing, monitoring and enforcement; scientific and technical support for fish and wildlife habitat, disease and ecological problems; generation of basic data on contaminant levels in fish and rivers; soils and revegetation research; environmental toxicology research; and technology development for waste management and water treatment.

Substantial amounts of information have been provided to clients, serving as the basis for decisions in areas such as wildlife management, industrial regulation, agricultural pesticide use and many more.

Among the accomplishments in the past five years is development of a state-of-the art analytical capability, allowing the Centre to detect chemicals at parts per billion concentrations or lower. This capability has been applied each year to thousands of samples requiring over 350,000 individual tests. In addition to developing and using new methods of air and water analysis, the Centre instituted an analytical scan for priority pollutants, detecting and identifying substances believed to be of particular environmental concern.

A geochronology laboratory was developed, providing the province with the ability to determine the rate of change of processes such as erosion and reservoir recharge, and providing an archaeological dating service.

The Centre's chemical damage investigation service, the only one in western Canada, recorded a steady increase in the demand for its services in cases of suspected chemical injury to plants. It annually diagnoses several hundred cases of suspected chemical injury to plants caused by accidents or misuse of herbicides and fertilizers.

A study has been completed to determine concentrations of chemical residues in fish in major Alberta water systems. Follow-up work on new sites and on selected chemicals is being carried out, and studies are being extended to birds and mammals.

The Centre has developed the facilities and programs which give Alberta a lead in inhalation toxicology research. A $1.8 million inhalation toxicology laboratory, one of a very few in North America, was completed and research has started on the effects of inhaling sulphur gases.

Promising results have been obtained in biological control of insect pests. For example, insects have been successfully controlled at the Muttart Conservatory in Edmonton with the use of natural enemies of the pests, reducing the need for chemical sprays.

Advances were recorded in several areas in the development of new technology for pollution control. A process for reducing sulphur emissions from industrial plants has been successful in the laboratory and in a pilot test at a natural gas processing plant. While reducing emissions, the process produces a byproduct with potential use as fertilizer and in various industries. Studies have also started on the solidification and incineration of hazardous wastes and the treatment of industrial effluents, and a water treatment plant was built which recycles 90 percent of used water from fish tanks.

A growing volume of services to the public was provided, directly and through other government agencies. Through the provincial Health Units, the Centre regularly tests nearly all drinking water used by the public. Services were provided to the agricultural community in the Centre's capacity as Alberta Agriculture's Regional Crops Laboratory for northeastern and northcentral Alberta.

The Centre served more than a dozen clients; the main ones were the Departments of Agriculture, Energy and Natural Resources, Environment, Social Services and Community Health, and Workers' Health, Safety and Compensation as well as the Alberta Research Council and Public Health Units.

In the past fiscal year, representatives of two additional departments – Economic Development and Social Services and Community Health – were added to the Centre's Board of Directors and Technical Advisory Committee.

In the following pages, activities in Programs in 1984-85 are highlighted. These Programs are organized under the following nine Program Areas.

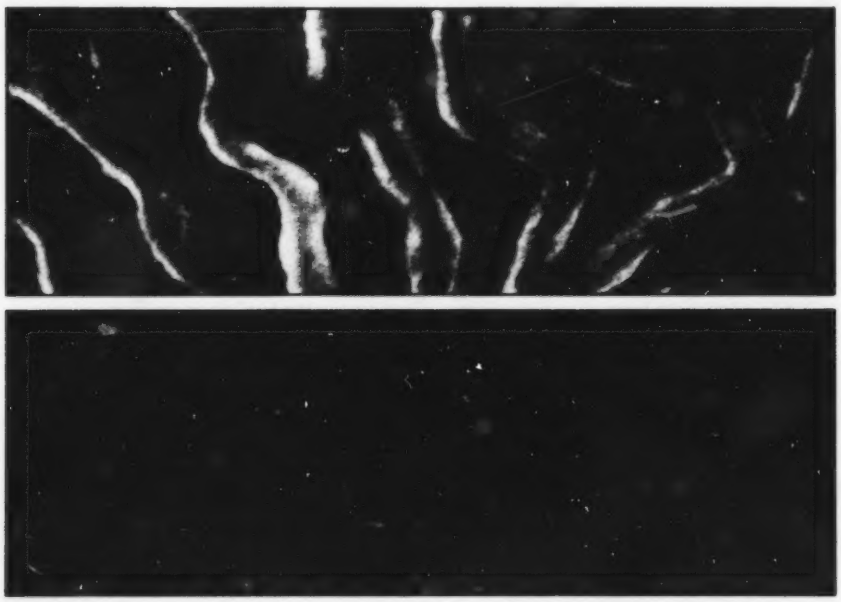
- Analytical, Diagnostic, Extension and Technical Services
- Pest Management Research and Development
- Water/Wastewater Management Research and Development
- Environmental Toxicology
- Living Natural Resources
- Waste Management Research and Development
- Land Resources Management Research and Development
- Technical Support
- Administrative Support

ANALYTICAL, DIAGNOSTIC, EXTENSION AND TECHNICAL SERVICES

The majority of services provided to government departments and agencies and the public was offered in this Program Area. These services included the detection, description and understanding of environmental agents and substances and ranged from an array of chemical analysis services to assistance in wildlife capture.

PROGRAMS:

- Air Analytical Services
- Aquatic Biology Services
- Chemistry Research Services
- Electron Microscopy Services
- Geochronology Services
- Lake Nutrients
- Microbiological Services
- Pest Management Diagnostic and Extension Services
- Precipitation Studies
- Quality Control and Data Management
- Soil Analytical Services
- Toxicology Services
- Trace Organics Analysis and Methods Development
- Water Analytical Services
- Wildlife Biology Services



Geranium pollen is shown here at two magnifications under the electron microscope.

AIR ANALYTICAL SERVICES

Routine air quality analyses were performed on gases from industrial smoke stacks and on ambient air. Stack emissions were analyzed from 18 industrial plants including chemical, cement and fertilizer plants, pulp and paper mills, power plants and oil sands upgrading plants such as Suncor and Syncrude. These samples provided data for enforcement and licensing personnel in Alberta Environment.

Samples were also collected and tests performed in the ambient air testing program. Following collection from air monitoring stations throughout Alberta, air was tested for particulates, lead and other metals, benzo(a) pyrene, hydrogen sulphide and other sulphur gases, fluorides and nitrogen oxides. As well, tests were conducted on samples in a vinyl chloride monitoring project.

More than 7,800 ambient air and stack sample tests were performed, involving over 19,000 individual tests.

Development of new test methods for substances in air continued.

AQUATIC BIOLOGY SERVICES

Steps were taken to form a response team involving scientists from several disciplines for the investigation of fish mortality incidents. A team was trained in the collection of samples and measurements at fish kill sites and a sampling kit was assembled.

A water treatment system was maintained, operated and upgraded, recycling 90 percent of the water used in Centre fish tanks.

Several bioassays were conducted using rainbow trout to determine the toxicity of industrial effluents. Results were provided to Alberta Environment.

CHEMISTRY RESEARCH SERVICES

Assistance was provided in the calibration and fine tuning of gas chromatographic equipment used for toxic gas analysis. On behalf of the Plant Sciences Wing, analytical method development and the analysis of sixty samples was undertaken for Larvadex pesticide and its metabolite Melamine in chicken tissue.

A cooperative project was completed between the Centre and the University of Guelph in which a graduate student completed some of the requirements for his doctoral degree. Field work for a project on the use of littorocorrals to investigate the impact of Lorsban on sloughs was completed. Routine water parameters, and pesticide residue samples from slough sediment and water were collected and analyzed.

ELECTRON MICROSCOPY SERVICES

During the year, a total of 277 electron microscopy investigations were carried out and 2,500 micrographs were prepared. Ultrastructural studies were conducted on fish gill tissues exposed to flocculants and effluents. Other services included identification of plant and animal viruses, bacterial flagellae, asbestos fibers, particulates and pollen grains. Diagnostic analytical electron microscope services were provided to the Animal Health Division of Alberta Agriculture. The University of Alberta Franklin expedition project also submitted tissue samples for electron microscope analyses.

Work continued in the development of electron microscope methods. Quality control and quality assurance procedures were established and an electron microscope study on the mechanism of hexavalent chromium uptake by a bacterium was published.

GEOCHRONOLOGY SERVICES

Tritium and radiocarbon dating services were provided, generating information for approximately 20 environmental studies being undertaken by Alberta government departments and agencies. The radiocarbon application was largely to determine chronologies of natural events such as sedimentation, and rates of natural environmental processes. Tritium analysis was used primarily in areas such as determining the rates of water recharge, infiltration and mixing. For example, work was undertaken for an Alberta Agriculture – Alberta Research Council dryland salinity study and for on-going research at several archaeological sites. Information was also generated for a Centre study of mercury in southern Alberta river and stream sediments.

LAKE NUTRIENTS

Surveys of water quality in selected river basins in Alberta were conducted for Alberta Environment in support of investigations into the eutrophic status of lakes. A total of 20,000 chemical determinations were provided on 600 samples submitted under this project. Some of the large surveys included the Athabasca River, Red Deer River, and Cold Lakes, Beaver River studies.

MICROBIOLOGICAL SERVICES

Diverse enumeration techniques and computer assisted rapid and comprehensive identification series were used to provide microbiological services to various Centre and provincial government user groups. These involved the analysis of 332 samples for 7,124 parameters. These services were offered, on a limited basis, for the first time to clients outside the Centre to support their services and research programs.

As part of an ongoing quality control/assurance effort, 6,813 parameter checks were conducted to monitor the performance of various equipment, the purity of over 100 microbial cultures and the acceptability of prepared growth media.

Computer software programs were developed for electronic data capture of plate counts from an Artek automatic colony counter, statistical analysis of plate count data, and production of weekly and quarterly reports.

PEST MANAGEMENT DIAGNOSTIC AND EXTENSION SERVICES

The Centre continued its functions as Alberta Agriculture's northeastern and northcentral Regional Crops Laboratory. This involved providing insect, plant disease, weed and chemical damage diagnostic and extension services to Alberta Agriculture's three other regional crops laboratories and to extension personnel, farmers and gardeners in this area. The diagnostic services included identification of over 2,300 pest specimens including 634 insects, 1,392 plant diseases and 350 weeds. As well, 485 investigations were conducted into cases of suspected chemical damage to plants, involving 1,150 plant, soil and water specimens.

Surveys were conducted on bertha armyworms and root maggots in canola, Verticillium wilt of alfalfa, cereal and canola diseases and weeds. Diagnostic support continued for a provincial survey of bacterial ring rot of potato.

Staff conducted an active agricultural extension program, holding a Crops Field Day, providing information to the farm news media, and conducting courses for extension agents, students and others.

PRECIPITATION STUDIES

Precipitation samples from six monitoring stations were routinely analyzed. During the year, approximately 300 samples were analyzed with 3,500 individual tests. Another 40 samples were analyzed with 500 tests as part of four quality control studies under the federal government Long Range Transport of Atmospheric Pollutants (LRTAP) study. A special project was undertaken jointly with the Air Quality Control Branch to find the reason for unusually high sulphate and pH readings in precipitation samples collected from Calgary and area.

QUALITY CONTROL AND DATA MANAGEMENT

External quality control in the form of collaborative studies continued with participation of numerous laboratories under the auspices of the following:

- Prairie Provinces Water Board for water quality parameters;
- The Freshwater Institute for determination of mercury in fish;
- Alberta Environmental Centre for vinyl chloride monitoring in air;
- National Water Resources Institute special study on low level sulfate;
- Long-Range Transportation of Air Pollutants (LTRAP) for major ions and nutrients.

During this period, other external proficiency tests were added such as:

- Technical Services/Alberta Environmental Centre for determination of the elemental composition of kidney tissue;
- Federal Interdepartmental Committee on Pesticides for determination of herbicides;
- Alberta Water Analysts Committee for determination of 22 water quality parameters;
- U.S. Environmental Protection Agency for determining the levels and types of microbiological organisms in a recently developed Standard Reference Material.
- Lake Diefenbaker Study for routine and nutrient parameters.

Internal quality control programs were intitiated for certification of analytical weights throughout the Centre. Internal proficiency studies were conducted within the Chemistry Wing and between the other Wings of the Centre.

Drinking water analysis is one of the Centre's largest service programs.

SOIL ANALYTICAL SERVICES

Instruments were installed to provide soil chemistry, engineering and physics tests for environmental purposes. Soil analyses were carried out for a survey of soil on the Centre site to determine land variability for research management purposes. Other soil tests were done to support work in areas such as soil compaction and root growth, weed science, and vegetation ecology.

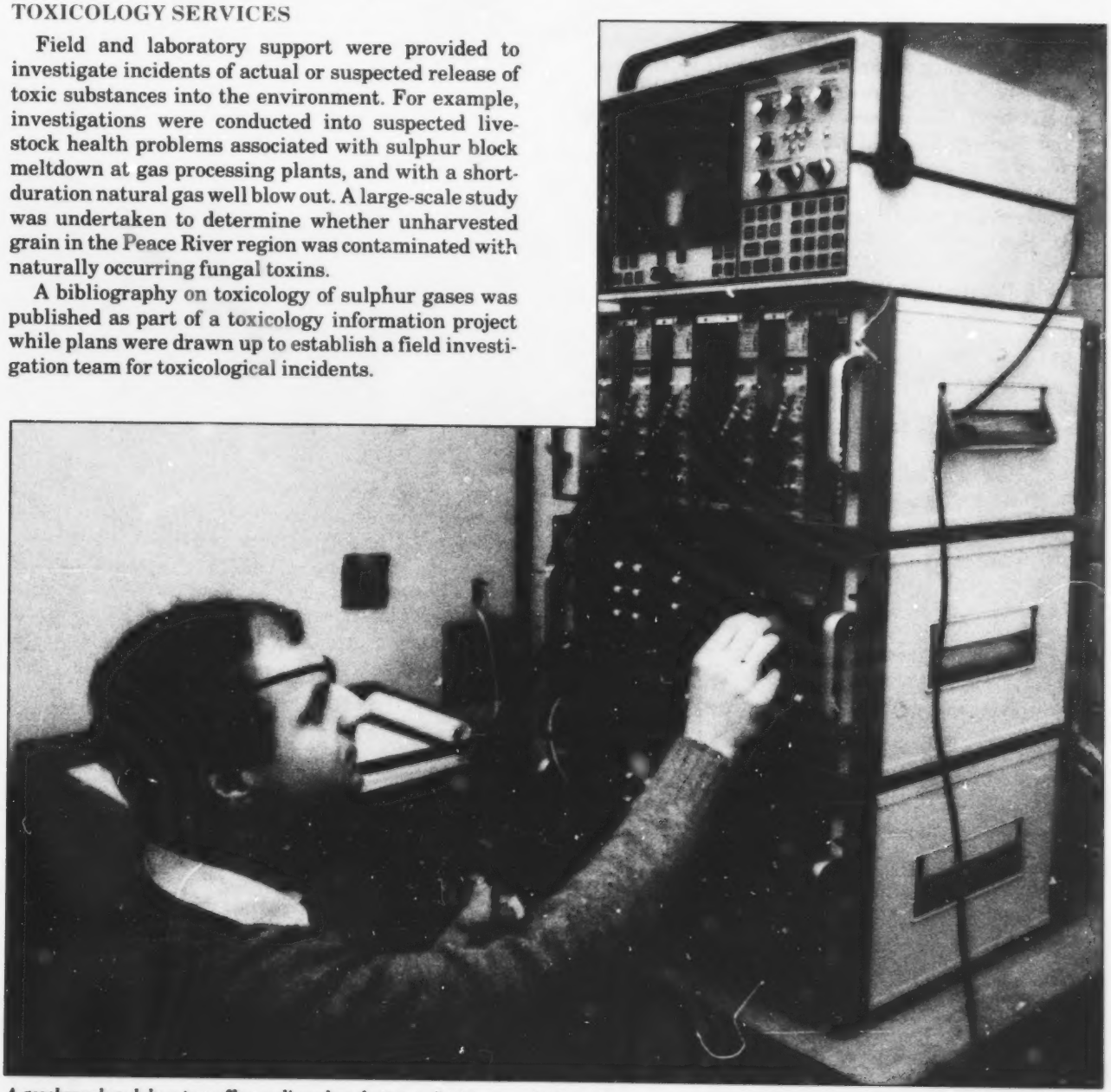
TOXICOLOGY SERVICES

Field and laboratory support were provided to investigate incidents of actual or suspected release of toxic substances into the environment. For example, investigations were conducted into suspected livestock health problems associated with sulphur block meltdown at gas processing plants, and with a short-duration natural gas well blow out. A large-scale study was undertaken to determine whether unharvested grain in the Peace River region was contaminated with naturally occurring fungal toxins.

A bibliography on toxicology of sulphur gases was published as part of a toxicology information project while plans were drawn up to establish a field investigation team for toxicological incidents.

TRACE ORGANICS ANALYSIS AND METHODS DEVELOPMENT

Priority pollutant analysis, polychlorinated biphenyl and hydrocarbon identification techniques have provided some of the analytical services for organic constituent determinations. A total of 688 samples was analyzed for a range of organic constituents, primarily for the enforcement of laws that ensure



A geochronology laboratory offers radiocarbon dating and tritium analysis services.

safe and clean water and air throughout the province. Of these, 86 per cent were performed for Alberta Environment's Pollution Control Division.

Comprehensive analytical support to Alberta Environment's Municipal Engineering Branch was provided for monitoring selected water treatment plants, which serve approximately half of the population of Alberta. Various industrial effluent samples were analyzed for Alberta Environment's Water Quality Control Branch as part of a survey program of river basins in the province. This work also entailed analysis of the receiving waters and sediments at various locations on water courses including the Athabasca, Elbow, Beaver, North Saskatchewan, Red Deer, Lovett and Nordegg Rivers. Hydrocarbon fingerprinting services were provided for approximately fifteen petroleum product spill sites in connection with Pollution Emergency Response Team requests. Support was provided to ensure the safe containment of a number of hazardous chemicals at different locations.

Public Health Unit samples amounted to seven per cent of the total work, as did the service work provided to the Centre.

WATER ANALYTICAL SERVICES

A total of 13,630 samples was submitted under this program, including samples for drinking water analysis, pollution monitoring and water quality investigations. The distribution of analytical tests to individual departments was as follows:

	Samples	Analytical Determinations
Health Units	7,200	112,500
Pollution Control Division	5,500	105,600
Alberta Environmental Centre	710	15,500
Other Departments	220	4,100
Total	13,630	237,200

The majority of samples received and tests performed were required to determine the suitability of drinking water for human consumption from municipal and private well sources. Water chemistry analytical support was provided to enforce the Clean Water Act, license limit discharges and for studies associated with environmental concerns.

Analytical services to Centre managed programs were conducted to support water and wastewater treatment programs in the Environmental Technology Wing and fish holding facilities in the Animal Sciences Wing.

Analytical support for the Forestry Research Branch of Energy and Natural Resources was primarily devoted to the Tri-Creeks Project, a study of the effects of forestry operations on fish.

WILDLIFE BIOLOGY SERVICES

Staff provided assistance and advice to a number of agencies on several wildlife problems and projects. For example, Fish and Wildlife personnel requested the help of Centre staff in locating an injured grizzly bear in the Swan Hills area. The Saskatchewan Wildlife Branch requested the use of Centre capture nets for a caribou capture program in that province, and staff provided advice to wildlife personnel in Saskatchewan and Colorado on the use of the Centre's net gun in cold weather.

Project development work centered on a feasibility study of carrying out research into the causes of high moose calf mortality rates in northeastern Alberta. This included an investigation into moose capture techniques, and tracking of radio collared animals. The results were intended to determine whether a more in-depth, long-term study on the situation is appropriate.

PEST MANAGEMENT RESEARCH AND DEVELOPMENT

Research into ways of reducing pest damage through the use of integrated environmentally sound control was emphasized in this Program Area. Chemical, biological and cultural control methods were examined and chemical studies were carried out to detect and analyze pesticides in the environment.

PROGRAMS

- Biological Control of Weeds Research and Development
- Biology and Ecology of Weeds Research and Development
- Herbicides and Weed Management Research and Development
- Insect Pest Management Research and Development
- Pesticide Analysis and Methods Development
- Plant Pathology Research and Development

Biological weed control is the focus of a major research effort.

BIOLOGICAL CONTROL OF WEEDS RESEARCH AND DEVELOPMENT

Studies on weed control by insects progressed on several fronts. Information was collected to produce a priority list of weeds for biological control. Leafy spurge, perennial sow-thistle, toadflax and Canada thistle were selected as the initial target weeds.

Work continued on the introduction, release and monitoring of insect control agents in co-operation with the Commonwealth Institute of Biological Control (CIBC) in Switzerland and Agriculture Canada's Regina Research Station which screen the insects prior to release.

Under a three-year contract with CIBC, one insect species was screened and cleared for release for leafy spurge control. Pre-release studies on another insect for leafy spurge control were well advanced.

Studies progressed on the release and monitoring of insects which had been cleared for use. Two species released on leafy spurge at Cardston were found to have survived the 1983-84 winter. Colonies of four insect species attacking leafy spurge, Canada thistle and toadflax were received from Regina Research Station and reared in growth chambers in preparation for field release in 1985.

Studies were also planned to evaluate the effect of two insects (now established and widespread) on toadflax. A survey of disease organisms attacking perennial sow-thistle was also planned, and plans were made to survey insects attacking scentless chamomile, another possible target weed.

BIOLOGY AND ECOLOGY OF WEEDS RESEARCH AND DEVELOPMENT

Several trials were conducted to determine the effect of competition from various weeds in cereal crops and canola. Mathematical models were developed to estimate barley and wheat yield losses due to wild oats and Tartary buckwheat infestation. Field studies were also conducted on the reinfestation potential and long-term economic impact of threshold levels of wild oats. Growth chamber experiments were completed on soil moisture competiton between wheat and green foxtail and wheat and smartweed.

A survey of weeds for the provincial Weed Alert program was completed, and plans for an upcoming weed survey of cultivated lands were drawn up.

Studies were completed on a classification of various leafy spurge types and similar work on knotweed was started, both aiming at providing information needed for weed control.

Growth chamber experiments were initiated to study the effects of environmental factors on growth and development of hempnettle and smartweed. A long-term study on the survival of weed seeds in soil was continued.

HERBICIDES AND WEED MANAGEMENT RESEARCH AND DEVELOPMENT

Field, growth chamber and laboratory experiments were conducted to generate information on herbicide crop safety, effectiveness, behaviour and fate in plants and soil.

Fourteen field trials were completed, providing information on the performance of herbicides for canola and cereal weed control and the control of volunteer cereals in canola.

The tolerance of new canola and cereal varieties to selected herbicides was examined, as was the tolerance of succeeding crops to herbicide residues in soil. Studies on herbicide spray drift involved a study of the effects of low levels of certain herbicides on sensitive non-target plants.

Field experiments were completed on the persistence of three herbicides in soil, and further trials tested activated charcoal for inactivating soil residues of persistent herbicides such as picloram, bromacil and atrazine.

Field studies on the effects of environmental factors on herbicide performance were carried out in co-operation with four other research institutions in Alberta. Growth chamber experiments examined the influence of soil moisture stress on the performance of eight post-emergence wild oats herbicides.

Work was continued on the development of sensitive and practical biological techniques for detecting herbicides residues in soil and water samples.

INSECT PEST MANAGEMENT RESEARCH AND DEVELOPMENT

Studies on chemical and biological control of crop and livestock pests were conducted, and surveys were carried out to determine the significance of current and potential pests.

Field crop research concentrated on canola pests. Trials were conducted on the impact of flea beetle and root maggot damage on canola growth and yield, indicating that the crop can tolerate severe pest attacks. Populations of bertha armyworms were surveyed throughout Alberta and a guide for sampling of the pests was prepared to help determine if infestation is great enough to make spraying necessary.

The first summer's field work was completed on the development of on-farm techniques for protecting cattle from black fly attacks. Self-treatment backrubbers and sprays were tested. As well, wipe-on insecticides

for biting fly control on horses were investigated. Use of a parasitic wasp for housefly control was evaluated as was the effectiveness of a poultry feedthrough product to control houseflies in poultry farms.

Field research was continued on the evaluation of experimental products for the control of chrysanthemum leafminer, spider mite and thrips on greenhouse cucumbers and for control of greenhouse whitefly on tomatoes.

PESTICIDE ANALYSIS AND METHODS DEVELOPMENT

During the year, a total of 1,301 samples was analyzed for low level pesticide residues in water, sediment, soil and other substances.

Fifty-four per cent of the samples were analyzed for Alberta Environment's Pollution Control Division. Analyses were provided monthly to monitor pesticide residues in drinking water from selected sites across Alberta. Sample analysis from such rivers as the Bow, Oldman, Athabasca, Red Deer, Beaver, and Battle was provided to support monitoring programs of the Water Quality Branch. Soil, sediment and water samples were analyzed in support of work such as the Athabasca River black fly project, the pesticide container collection project and the Sikome Lake aquatic weed control project of the Pesticide Chemicals Branch.

Over forty-three per cent of the total samples were analyzed for the Centre's Plant Sciences Wing. Analysis of soil, foliage and water samples for herbicide residues was provided to the chemical damage investigation service. Additional samples were analyzed for Trifluralin and Triallate residues in support of the Centre's Herbicides and Weed Management research Program.

Two per cent of the sample analyses for residues of pesticides in water and soil was provided to Public Health Units. A further one per cent was analyzed for various other clients.

Work continued in the development of chemical analysis methods. Work was completed on the following methods:

- analysis of 34 individual organonitrogen and organophosphorus pesticides in water;
- analysis of the biocides Baygon, Monuron, Carbaryl, Diuron, Linuron, Barban, Dimilin and Rotenone in water;
- analysis of the herbicides Simazine, Atrazine, Metribuzin, Prometryne and Cyanazine in soil and vegetation.

Development work on the analysis of new herbicides in soil and vegetation continued.

PLANT PATHOLOGY RESEARCH AND DEVELOPMENT

Plant disease research focused on areas such as chemical control, the cause and spread of diseases and disease management.

Chemical disease control trials were conducted on: root rot and smut of barley and wheat; seedling blight and sclerotinia stem rot of canola and lentils; and glume blotch of wheat and net blotch of barley. The influence of herbicides on the development of glume blotch of wheat and net blotch of barley was also investigated.

Field experiments on alfalfa decline involved monitoring the response of the forage to different sulphur treatments and innoculating plots with three fungi suspected to be associated with the disorder. Alfalfa varieties were also evaluated for susceptibility to various diseases and a study of 15 annual Brassica species was conducted to evaluate their potential for fall grazing pastures.

In co-operation with other agencies, surveys were conducted on diseases of alfalfa, barley, wheat and canola. One of the diseases identified was blackleg of canola which was found in six fields. It was identified for the first time in Alberta in 1983.

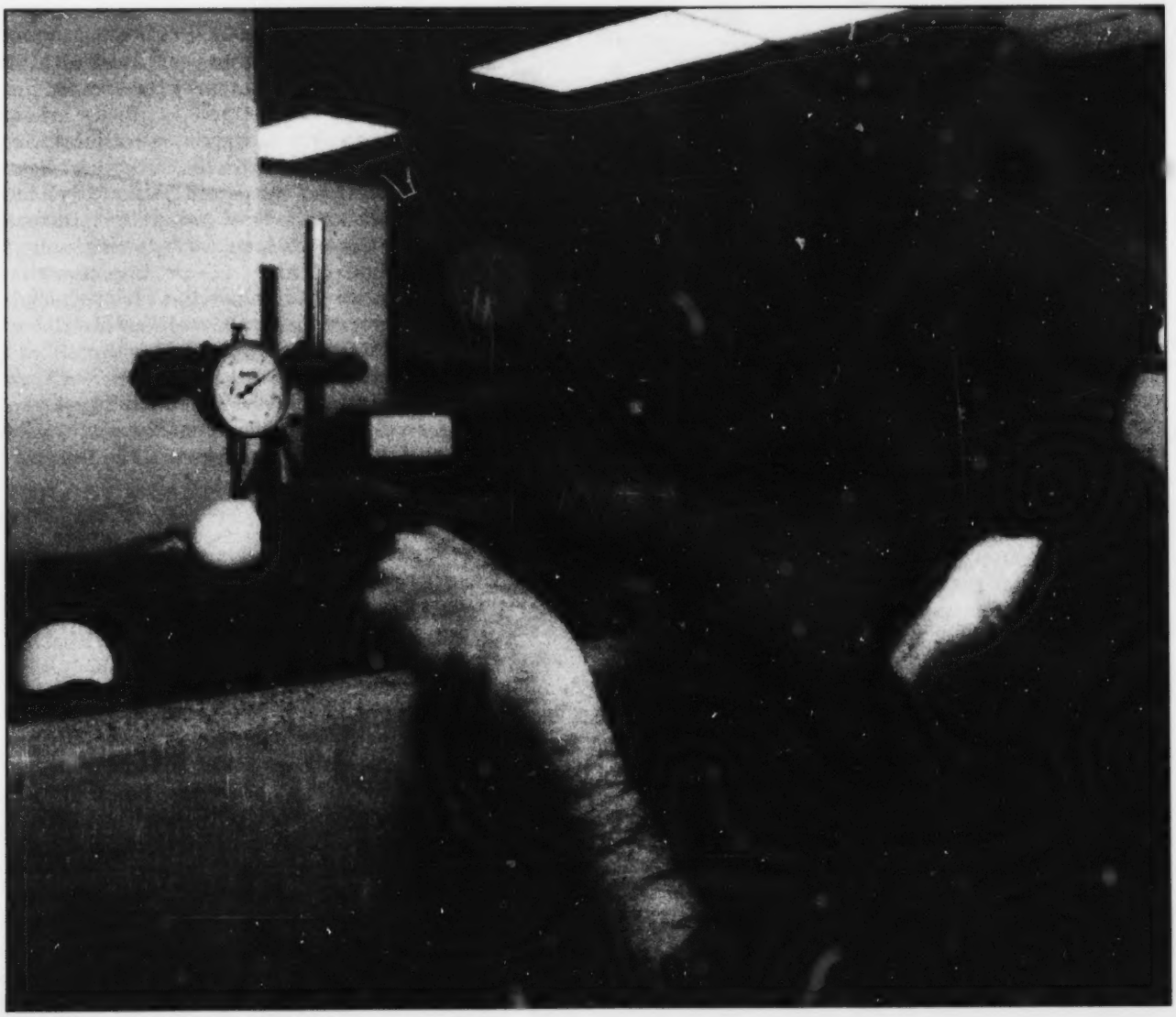
A study was completed using a fungus and a bacterium for root-knot nematode control in greenhouses.

WATER/WASTEWATER MANAGEMENT RESEARCH AND DEVELOPMENT

Four major Programs in this area involved staff in studies on subjects ranging from chemical residues in fish and birds to water treatment technology development. Ensuring a supply of high-quality water for a variety of uses while keeping environmental impacts to a minimum were the underlying objectives in this work.

PROGRAMS:

- Aquatic Toxicology
- Chemical Residues
- Potable Water Technology Research and Development
- Wastewater Technology Research and Development



Effects of chemical residues on bird reproduction are studied.

AQUATIC TOXICOLOGY

Studies were undertaken to determine the actual or potential harmful effects of wastewaters on natural water systems and the life forms those systems support.

Studies on the effects of effluents progressed in part through the adaptation and use of laboratory methods normally applied to commercial product safety testing. These techniques allowed an assessment of acute as well as longer-term effects of effluents on aquatic organisms.

Among the laboratory studies undertaken were fish blood analyses to determine body fluid changes during toxicity experiments and use of electron microscopy to assess pathological changes in fish tissues associated with industrial effluents.

Substances studied included pulp mill effluent, municipal sludge treatment and coal mine dewatering agents.

CHEMICAL RESIDUES

Following earlier Centre surveys of mercury residues in fish, studies were undertaken to determine whether the mercury was of natural or industrial origin. Analysis of soil and sediment samples indicated that the mercury was of natural origin and probably resulted from disturbance of soils with high natural concentrations of mercury. Studies also continued on mercury residues in fish from various Alberta waters.

Centre staff, working closely with biologists from other agencies, became involved in a program to reintroduce peregrine falcons to Alberta. Centre work involved capturing peregrine prey such as gulls and pigeons, and testing these for pesticide, PCB and mercury levels. This provided information on the effects of the chemicals on peregrines and on areas which may be suitable for peregrine falcon release.

Environmental contaminant levels were also determined in double-crested cormorants in work aimed at finding if chemical residues originate in Alberta or in the birds' overwintering locations. The research also examined the effects of residues on bird reproduction and the geographic variation in exposure to chemicals in the province.

Field work was complemented with laboratory studies on the toxicity of various forms of metals which may be found in the environment.

POTABLE WATER TECHNOLOGY RESEARCH AND DEVELOPMENT

Work concentrated on evaluating current and new technology to deal with specific drinking water problems in the province, emphasizing safety, quality and quantity of potable water supplies.

A mobile water treatment plant, built by a small Alberta firm, was delivered to the Centre late in the fiscal year. The plant provided the Centre with the ability to conduct field tests into the treatment processes needed for various water supplies throughout the province. Initial work of the treatment plant is to concentrate on problems such as treatment of drinking water receiving effluent from various industrial sources.

With a large portion of Alberta's population relying on groundwater, the investigation of technology for treating this water source received considerable emphasis. For example, the Centre started a co-operative project to test technology to remove iron from well water. Initial plans were to test a process to remove iron from water in aquifers, with emphasis on its effectiveness in Alberta, its effects on aquifers, and costs.

WASTEWATER TECHNOLOGY RESEARCH AND DEVELOPMENT

Studies were conducted to provide an independent assessment of industrial wastewater treatment proposals, providing Alberta Environment with information needed to evaluate applications to discharge treated effluents.

Considerable progress was recorded in studies on the treatment of pulp mill effluent. Three methods of removing color from these effluents were considered and two of these were examined in detail. In one case, around 120 fungal species were screened for their effectiveness in removing color. Several of the most promising species were selected for further study and plans were drawn up for larger-scale testing. Chlorination treatment of pulp mill effluent was investigated as well.

A lagoon modelling study was started to generate information needed by Alberta communities in the design and installation of new lagoons.

ENVIRONMENTAL TOXICOLOGY

The potentially harmful consequences of chemicals or agents of natural or human origin were examined in this Program Area.

PROGRAMS:

- **Environmental Sulphur**
- **Chemical Safety Evaluation**
- **Inhalation Toxicology**
- **Toxicology of Biocides**
- **Toxicology of Petrochemicals and Fossil Fuels**

Blood tests are conducted in conjunction with various research projects.

ENVIRONMENTAL SULPHUR

Studies continued on the effects of sour gas plant sulphur emissions on livestock. In a trial at the Centre, cattle were fed normal and high levels of dietary sulphur and compared for feed consumption, weight gain and other characteristics. Laboratory studies were also conducted on the interaction of dietary sulphur with selenium. The study was aimed at determining whether increased dietary sulphur affects the use of selenium by the animals.

Analysis and reporting of results continued on related research such as effects of a gas well blowout on livestock and an on-farm pilot study of levels of sulphur and trace minerals in soil and feed crops.

CHEMICAL SAFETY EVALUATION

This Program continued on a contingent basis, providing the capability of carrying out a complete chemical safety evaluation of agents of environmental concern. The Centre also responded to a number of requests from governments, universities and industries for information on the hazards of particular chemicals or mixtures together with an assessment of risk.

INHALATION TOXICOLOGY

Work was completed on the design and construction of a 4,000 square foot inhalation toxicology laboratory. The facility was designed to generate and evaluate the potentially toxic effects of gases, particulates and vapors at environmental and occupational concentrations. Computer-controlled equipment was installed for the intake and cleaning of air, safe generation of aerosols and cleaning of exhaust gases.

Initial toxicity studies began in a bench-scale exposure system, and numerous technical methods required for the inhalation work were developed and made operational.

The first gas under study was hydrogen sulphide. Among the initial problems identified for investigation were the chronic toxicity of sulphur gases, their interactions with hydrocarbon condensates released by well blow-outs, and their effects on lung function and body defense mechanisms.

TOXICOLOGY OF BIOCIDES

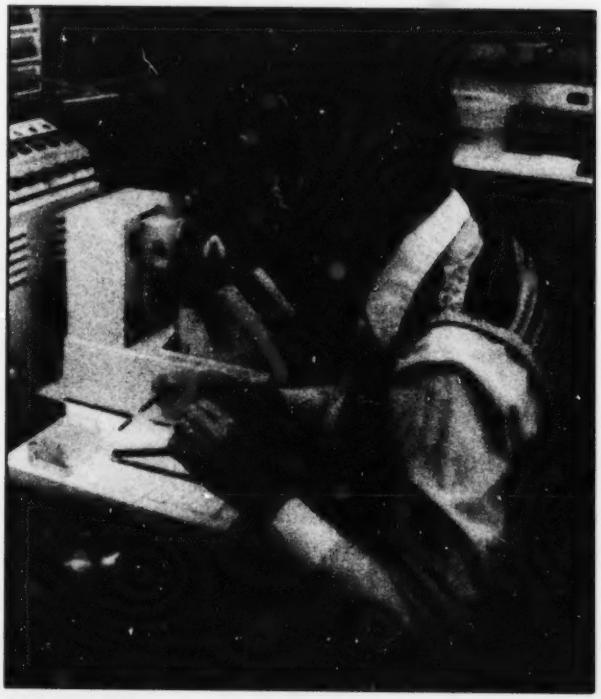
Pesticide residues and effects of pesticides on non-target species have been identified as major potential areas of research in this Program. Ten priority pesticides have been identified as subjects for active research. Studies continued on the sensitivity of cattle to certain insecticides.

TOXICOLOGY OF PETROCHEMICALS AND FOSSIL FUELS

Concern about potential contamination of the Athabasca River system due to natural seepage or oil sands extraction led to the start of two projects. One is investigating the levels of certain hydrocarbons in fish tissue. Laboratory analytical methods were developed for 10 of these compounds and development of detection methods for another 10 were started. Fish were collected at several sites on the Athabasca River and their tissues analyzed for residues of the hydrocarbons.

The second study is aimed at determining the toxicity to fish of tar sands holding pond effluents. These studies were carried out with the effluents and with suspended solids and natural bitumen from the Athabasca River.

Work started in developing tests for measuring hydrocarbon toxicity in animals, for studies planned on crude oil toxicity to animals, particularly livestock.



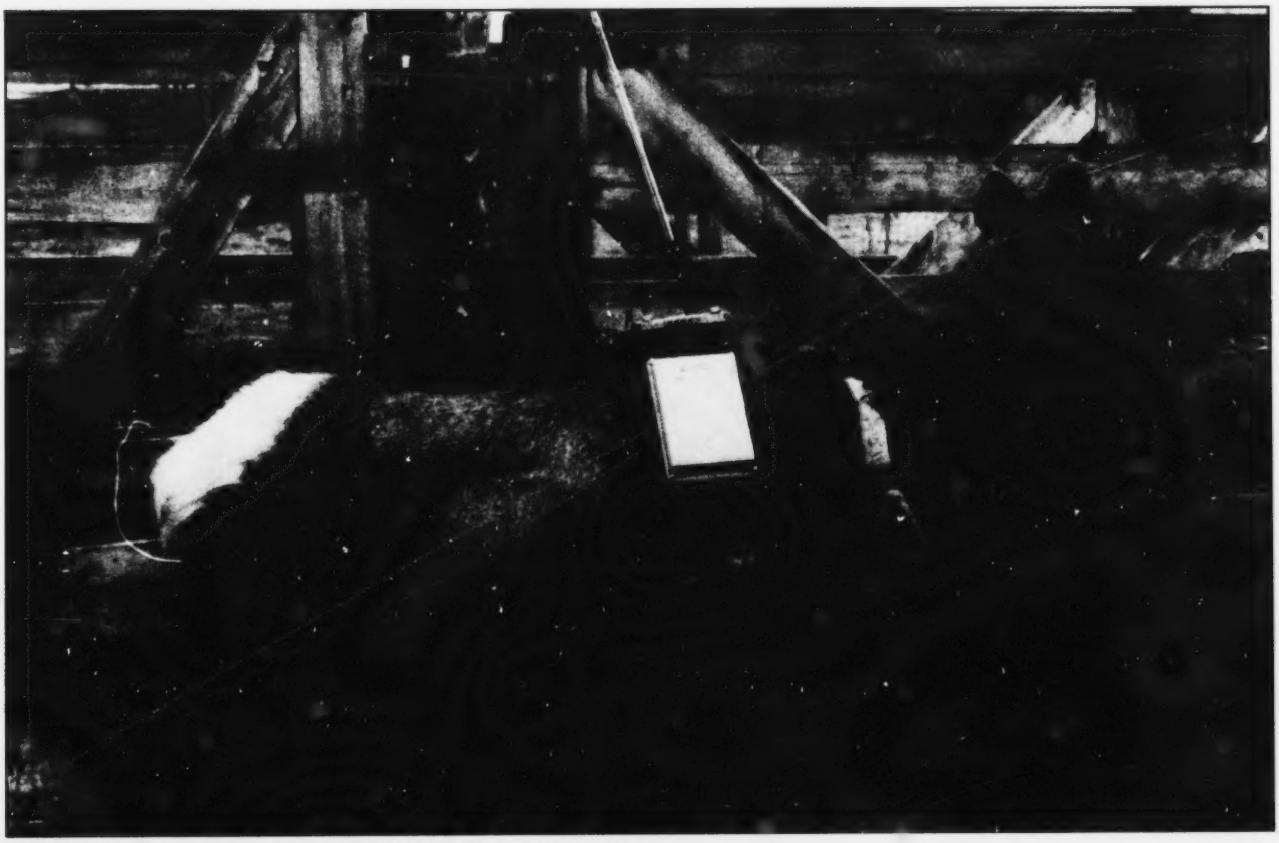
Microscope slides are prepared for studies in animal sciences.

LIVING NATURAL RESOURCES

Fish, moose, bear, elk, coyotes and a variety of other species were the focus of work in this Program Area. Staff travelled widely in Alberta conducting studies on a range of environmental changes which may affect living natural resources.

PROGRAMS:

- Aquatic Habitat Studies
- Forestry Development and Wildlife Resources
- Humane Trapping
- Problem Wildlife
- Wildlife Productivity



A physiological monitoring system was developed for large animal studies.

AQUATIC HABITAT STUDIES

A study of the Dickson Dam reservoir was launched to monitor native and stocked fish populations, providing information needed to predict events and trends in Alberta reservoirs.

The study was designed to describe changes in mercury levels in fish in the Dickson reservoir and changes in the species composition of the fish population. Two collection trips were made and the fish were examined to determine age, sex and size and other information. Muscle samples were removed for mercury analysis and stomach contents were examined to determine diet and major prey.

FORESTRY DEVELOPMENT AND WILDLIFE RESOURCES

This large field project entered its final phase with concentration on analysis and reporting of data collected during five years of study on the effects of forestry operations on wildlife in the Berland Timber Management area. The information was generated through studies including the live capture of over 100 grizzly and black bears and surveillance of 38 of them equipped with radio collars.

As well, satellite imagery was used to prepare detailed habitat maps of the area, and to relate animal activity to habitat.

Information is being analyzed on such topics as bear population biology, home range area, food habits and use of electronic devices for wildlife studies.

HUMANE TRAPPING

A formal agreement was reached between Alberta and the Fur Institute of Canada to embark on a five year co-operative program of research at the Centre on humane trapping systems. This led to a review of scientific literature on humane trapping, previous trap testing programs and issues in the fur industry. Development of facilities for the Program was started.

PROBLEM WILDLIFE

In studies on vertebrate pests of agricultural concern, toxic collars were evaluated for use by sheep producers to control coyote predation. This included completion of work to characterize what type of lambs are killed by coyotes, providing information on which lambs in a flock should be fitted with the poison-containing collars. Staff also developed an audio-tape device, which emits sounds of a distressed lamb, to attract problem coyotes to lambs wearing toxic collars.

Research was also conducted into alternatives to strychnine for skunk control.

This Program also included an identification service for Alberta Agriculture in which feces, hair and animals were examined in suspected cases of rodent infestations.

WILDLIFE PRODUCTIVITY

Several studies were undertaken to provide information for intensive big game management in Alberta, especially game ranching. This research focused on wildlife food and shelter requirements.

A game ranching pilot study was established in co-operation with the Kikino Game Ranch. Preliminary work included the assembly of detailed aerial photos of the site and a vegetation inventory to establish the wildlife carrying capacity at the ranch.

Planning and experimental design for studies on the palatability and suitability of revegetation forages for wildlife were also completed.

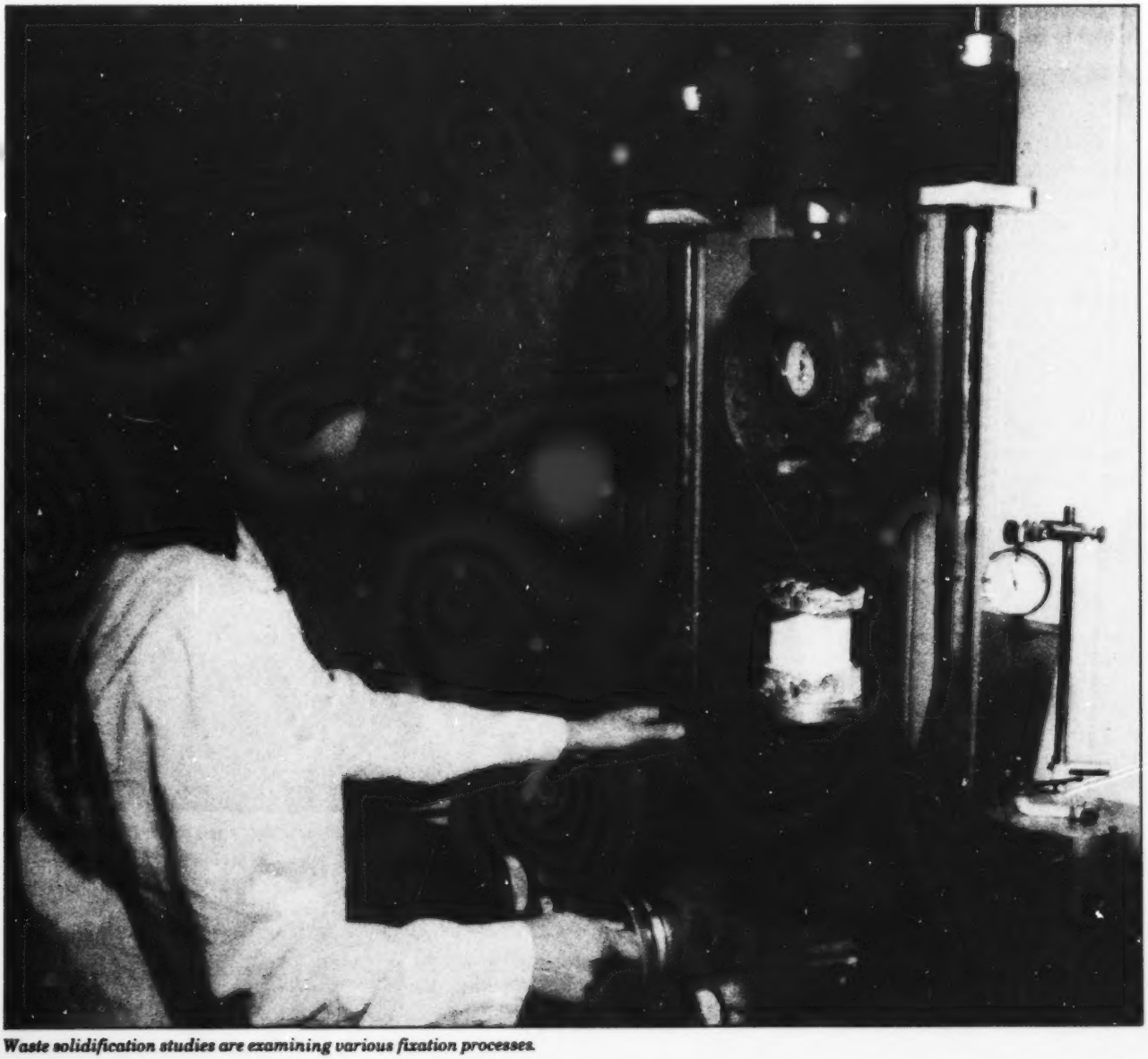
An electronic system was designed for monitoring the environment and physiology of free-ranging animals such as elk, allowing the remote collection of information on animal food and shelter needs.

WASTE MANAGEMENT RESEARCH AND DEVELOPMENT

Physical, chemical and biological processes for waste management were studied to reduce environmental problems and exploit the economic potential of wastes. This involved laboratory and pilot scale studies at the Centre and in the field.

PROGRAMS:

- Emission Control Technology
- Microbiological Processes in Waste Management
- Technology Development in Waste Management
- Thermal Conversion Processes



Waste solidification studies are examining various fixation processes.

EMISSION CONTROL TECHNOLOGY

Work continued on processes and systems designed to clean up exhaust gases given off by various industrial processes. Following testing of a system to remove sulphur from natural gas processing plant emissions, analysis showed that both the removal efficiency and the quality of the gypsum byproduct were high. As well, a private consulting firm reviewed the probable costs of using the system on a commercial scale, concluding that costs would compare favorably with existing processes.

MICROBIOLOGICAL PROCESSES IN WASTE MANAGEMENT

Microbiological processes and systems were used in three major projects to generate information on waste management and toxicity assessment. In one, seven surveys of four cattle feedlots were conducted under wet and dry conditions to determine the impact of feedlot wastes on nearby receiving surface waters. These surveys involved the analysis of 123 samples for 1,187 microbiological parameters and 32 samples for 1,290 chemical parameters. Data were statistically analyzed to generate information on the downstream transport and fate of various microbiological parameters.

The evaluation of two short-term microbial tests (Microtox and *Spirillum volutans*) for the acute toxicity testing of environmental samples was completed, resulting in the publication of two scientific papers. Work started on the development of a new microbial test for toxicity screening using the growth rate of *Pseudomonas fluorescens*. Fifty-eight samples involving 206 parameters were tested with this system.

Studies continued on the mechanism of microbial uptake of heavy metals. Included were the testing of soil microorganisms for hexavalent chromium tolerance, involving the analysis of 186 samples for 1,357 parameters. Some results of an electron microscope/x-ray analysis of the uptake of one form of chromium by a selected bacterium were published.

TECHNOLOGY DEVELOPMENT IN WASTE MANAGEMENT

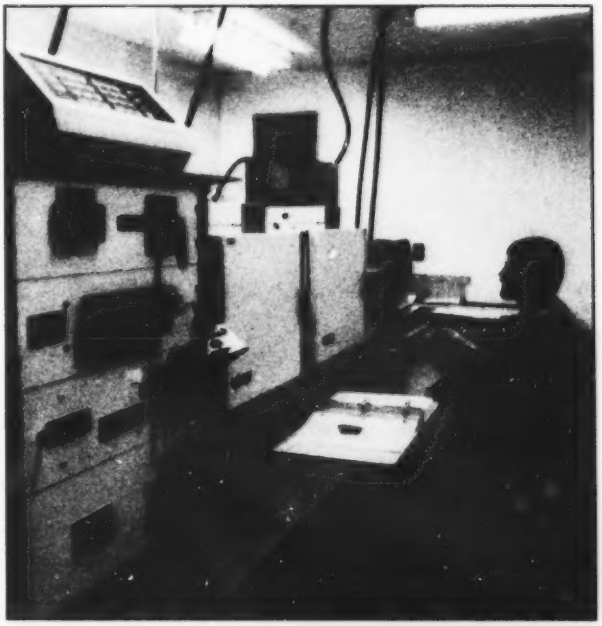
Work was started on the evaluation of stabilization and solidification processes for managing various wastes under Alberta conditions. Studies centred on developing test methods to assess the acceptability of fixation processes, under the wet/dry and hot/cold climatic conditions in the province. The work was carried out as part of a larger project in co-operation with Environment Canada, the U.S. Environmental Protection Agency and vendors of waste fixation technology.

This Program also encompassed planning for potential new projects such as use of fermentation processes in waste management.

THERMAL CONVERSION PROCESSES

Manpower, facilities and equipment were put in place for studies into the use of incineration for waste management. Plans were completed for construction of a building to house a pilot-scale combustion unit. A lab-scale system for incineration studies was obtained along with analyzers for the combustion products.

Research on incineration of hospital wastes with emphasis on emission control was identified as having high priority. Plans were drawn up for studies on burning hospital wastes beginning with the monitoring of emissions from an existing hospital incinerator.



Waste incineration studies are under way.

LAND RESOURCES MANAGEMENT RESEARCH AND DEVELOPMENT

The long term effects of major uses on Alberta's land resources were examined in this Program Area with emphasis on soil reclamation and revegetation.

PROGRAMS:

- Environmental Impact on Soil Ecology
- Native Species for Reclamation – Research and Development
- Soil Reclamation Research

Plants are studied as a means of removing water from oil sands tailings ponds.

ENVIRONMENTAL IMPACT ON SOIL ECOLOGY

Work concentrated on the development of soil ecology study techniques allowing the detection of subtle environmental changes before widespread impacts occur on water, plants and soil. The initial work investigated use of the nitrogen-fixing capacity of legumes as an indicator of adverse effects on the plant-soil system. Plans were also advanced for laboratory studies on the nature and rate of change in soils influenced by low levels of sulphur dioxide.

NATIVE SPECIES FOR RECLAMATION

Extensive plant collections were made in studies aimed at finding and improving native plants suitable for use in land reclamation. Studies were aimed at the eventual licensing and commercial production of plant species suitable for reclamation. Work concentrated on the selection of native grasses suitable for revegetating high-stress alpine locations.

Plants were selected at over 100 sites in the eastern slopes between the U.S. border and Jasper, mainly from disturbed or poorly vegetated sites over 2,000 metres in altitude. Four native species – alpine bluegrass, spike trisetum, mountain fescue and broad glumed wheatgrass – were transplanted from mountain areas to the Centre's nursery or taken to growth chambers for the study of plant survival under various conditions.

Shrub species were collected north of a line between Edmonton and Lloydminster for studies on plants suitable for oil sands mine reclamation. Difficult seed germination was the first problem addressed.

SOIL RECLAMATION RESEARCH

Applied research was begun in soil chemistry, physics and biology to identify constraints on land reclamation and provide efficient means of restoring land productivity and stability.

The major focus of soils research was in the reclamation of high sodium materials exposed during resource development. Staff began a province-wide collection of high sodium soil materials which were used in trials to study soil compaction and improve permeability. This included studies on improving these soils by adding gypsum, a potential byproduct of sulphur scrubbing in natural gas and other plants.

Related studies were undertaken to develop more accurate and reliable measurements of chemical and physical properties of high sodium materials.

A study was started to investigate the role of plants in controlling soil salinity. The experiment was designed to measure the amount of water used by various plant communities in relation to the depth to the water table.

Another study was started, in collaboration with Syncrude Canada Limited, to investigate methods of drying the tailings sand-sludge mixes remaining after bitumen extraction. Two plant species were identified which can remove vast amounts of water from these mixes in a 90-day growing season.

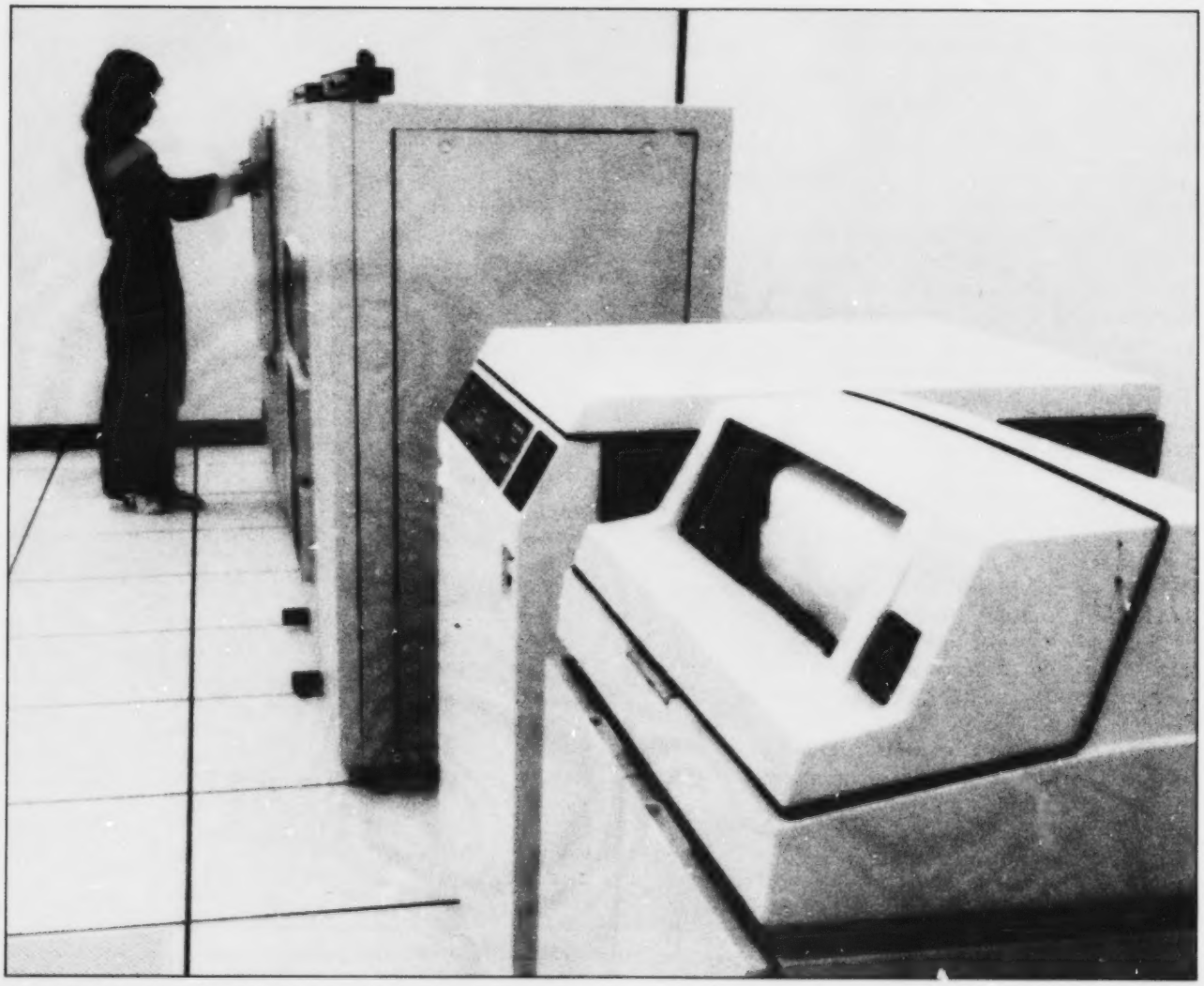
Hair grass is one native species being tested for use in revegetation studies.

TECHNICAL SUPPORT

A range of technical services was provided to support the Centre's scientific activities. This included operation of over $1 million worth of plant growth chambers, electronic repair, maintenance and design, and development of computer systems for laboratories.

PROGRAMS:

- Animal Resources
- Capital Facilities Development
- Controlled Environments
- Instrumentation Services
- Nutrition Services
- Pathology Services
- Site Environmental Services
- Site Support Services
- Computing Services



A mainframe computer is used in laboratory information management.

ANIMAL RESOURCES

Animals were maintained for animal-based research into subjects such as wildlife and aquatic biology and toxicology. Facilities were developed and upgraded as required and an animal care committee was established to oversee the care and use of animals.

CAPITAL FACILITIES DEVELOPMENT

The major construction project of the fiscal year was the inhalation toxicology laboratory which was completed in February. Other major facilities development undertaken included animal holding facilities, laboratory space development, and computer room construction, and design of an incineration research building and a greenhouse.

CONTROLLED ENVIRONMENTS

Thirty-six controlled environment growth chambers and two seed germinators were operated and maintained allowing plant and pest research during winter and under strictly controlled conditions. Growth chamber research was carried out on projects ranging from native grass selection to biological weed control.

INSTRUMENTATION SERVICES

Around 150 electronics maintenance requests were met, ranging from simple repairs to upkeep of complex electronic laboratory systems. Various electronic circuits were designed and installed, such as control systems and instrumentation for pilot plants. Staff also were involved in the design and assembly of novel electronic devices, such as an audio tape device for luring coyotes, and a biotelemetry system for the remote collection of heart rate, temperature and similar data from large animals.

NUTRITION SERVICES

Over 7,000 nutritional analyses were completed in support of on-going research programs and laboratory animal maintenance. Nutritional analyses were conducted for projects such as moose browse quality research and laboratory animal maintenance.

COMPUTING SERVICES

Major effort was directed toward development of a laboratory information management system for data produced by the Chemistry Wing. This centred around the mainframe computer which was acquired late last fiscal year. The new computer was extensively tested and areas where the system software needed changes were identified.

PATHOLOGY SERVICES

Necropsy, histopathology, ultrastructural pathology and clinical pathology services were provided largely in support of the following toxicology related studies: 1) toxicity of pulp mill effluents; 2) toxicity of coal mine effluents and flocculants; 3) toxicity of alum sludge; 4) toxicity of tar sands holding pond effluents; 5) toxicity of crude oil; 6) toxicity of sulphur; and 7) inhalation toxicology. Staff performed similar duties for several wildlife and aquatic biology projects to determine physiological and/or pathological alterations in tissues and blood of animals under study.

From all of the above studies, 851 animals were necropsied and 5,236 slides (or about 15,708 tissues) were processed and interpreted in the anatomic pathology laboratories. Some 1,581 blood samples (for about 24,000 blood parameters) were analyzed and interpreted in the clinical pathology laboratories.

SITE ENVIRONMENTAL SERVICES

An interim wastewater treatment plant and a pesticide collection system were operated to handle and treat wastes generated by the Centre.

A reverse osmosis water treatment plant was refined and enlarged, providing high quality water for laboratories.

SITE SUPPORT SERVICES

Activities on the Centre site were co-ordinated, including the assignment, development and preparation of areas needed for research plots and for large animal facilities. Some new experimental plots were established and old ones renovated. Roadways to wildlife project areas were built, electricity was supplied to cattle areas and grass was seeded between research plots for erosion and salt control. As required, equipment was built or modified for research purposes. As well, a large equipment and vehicle fleet was maintained.

ADMINISTRATIVE SUPPORT

Administrative Support services were provided as needed to advance the Centre's research, technology development and client services objectives. This support was provided to all Wings by the Common Services Wing, by administrative units attached to each Wing and through the management of the Centre facilities.

PROGRAMS:

- Administrative Services – Animal Sciences Wing
- Administrative Services – Chemistry Wing
- Administrative Services – Common Services Wing
- Administrative Services – Environmental Technology Wing
- Administrative Services – Plant Sciences Wing

Records management is one of many administrative services offered.

ADMINISTRATIVE SERVICES - ANIMAL SCIENCES WING

Extensive experimental design and data analysis services were provided in support of Centre studies.

Administrative activities included preparation of over 2,000 documents such as routine correspondence, purchasing and financial documents, research reports, journal manuscripts and two book manuscripts. Progress was recorded in acquiring and developing additional word processing capability.

ADMINISTRATIVE SERVICES - CHEMISTRY WING

The hiring of an office manager was a major addition to the Wing. To provide on-going administrative support, clerical staff were trained on a new enhanced word processing system. In addition to providing general administrative services, staff processed and distributed some 15,000 chemical analysis reports involving 350,000 chemical analyses and investigations.

An occupational health and safety program is offered to staff.

ADMINISTRATIVE SERVICES - COMMON SERVICES WING

Library, personnel, financial, communications and related services were provided in support of the Centre's technical and scientific activities.

The library served as a key element in technical projects, providing information through manual and computer-assisted reference searches, collection development and similar services. For example, 135 in-depth on-line computer searches were performed and 3,512 inter-library loans were processed.

Recruitment, staff relations and training activities were carried out by the Personnel Services Section. As well, an occupational health program was active, providing over 25 job related courses and organizing a Centre emergency response team.

Preparation and monitoring of the expenditure of the Centre's $11 million budget were among the financial functions performed. For general administration, an office automation word processing system was purchased and installed.

Information on Centre activities was provided through publications such as brochures and an Annual Review and through the news media. As well, over 500 visitors were shown through the building on tours and 700 people attended an Open House.

The Centre's Common Services Wing also supplied courier, mail, duplicating, filing, warehousing and other support services.

ADMINISTRATIVE SERVICES - ENVIRONMENTAL TECHNOLOGY WING

General administration services were provided including budgeting, staffing, planning, secretarial and clerical assistance. In addition, this program provided for the development of facilities and new projects and professional development of staff.

ADMINISTRATIVE SERVICES - PLANT SCIENCES WING

Administrative services were provided to Plant Sciences Wing operations. As well as administrative and clerical duties, the operation and maintenance of 36 growth chambers was carried out.

ALBERTA ENVIRONMENTAL CENTRE PROGRAM/PROJECT LISTS 1984/85

PROGRAM	PROJECT/SUB-PROJECT	CLIENT AGENCY
Air Analytical Services	Analytical Services (Air)	Environment
Aquatic Biology Services	Aquatic Biology Services	Energy and Natural Resources,
	Water Treatment System	Environment,
	Bioassay Services	Alberta Environmental Centre
	Environmental Issues in Western Societies	
Aquatic Habitat Studies	Dickson Dam Ecological Study	Energy and Natural Resources, Environment
Aquatic Toxicology	Biological Monitoring Research and Development	Energy and Natural Resources, Environment
	Toxicity Evaluation of Industrial Wastewaters	
	Toxicity Evaluation of Municipal Wastewaters	
Biological Control of Weeds Research and Development	Priority List of Weeds for Biological Control	Agriculture, Energy and Natural Resources
	Survey of Arthropods Attacking Selected Weeds	
	Introduction, Release and Monitoring of Arthropods	
	Biology and Host-specificity of Candidate Arthropods	
	Post-establishment Studies	
	Surveys of Plant Pathogens of Selected Weeds	
Biology and Ecology of Weeds Research and Development	Biology of Weeds of Alberta	Agriculture, Energy and Natural Resources
	Weed-Crop Competition	
	Weed Surveys and Population Dynamics	
	Taxonomy of Weeds of Alberta	
	Biology and Control of Aquatic Weeds	
	Literature Review of the Ecology of the Parklands in Alberta	
Chemistry Research Services	Health Units	Social Services and Community Health, Environment, Alberta Environmental Centre
	Alberta Environment	
	Pollution Control Division	
	Alberta Environmental Centre	
	Other	
Chemical Residues	Geochemistry of Mercury in Southern Alberta	Energy and Natural Resources, Environment
	Mercury Residues in Fish	
	Speciation of Heavy Metals	
	Chemical Residues in Colonial Nesting Birds	
	Chemical Residues in Peregrine Falcons	
Chemical Safety Evaluation	Risk Assessment Workshop	Agriculture, Workers' Health, Safety and Compensation, Environment
Electron Microscopy	Health Units	Social Services and Community Health
	Alberta Environment	Agriculture, Environment, Alberta
	Pollution Control Division	Environmental Centre
	Alberta Environmental Centre	
	Other Clients	
	Alberta Agriculture	
Emission Control Technology	On-site Pilot-scale Tests of Wet Scrubbing Processes for SO_2 Removal at a Gas Plant	Environment
	On-site Evaluation of a Wet Scrubbing Process for SO_2 Removal at a Tar Sands Plant	
Environmental Impact on Soil Ecology	Assessment of Pollution Impact on Soils	Environment
	Developing Criteria for Reclaiming Industrial Sites	
Environmental Sulphur	Effects of Sulphur on Livestock Production	Agriculture, Environment
Forestry Development and Wildlife Resources	Industrial Development and Wildlife in the Boreal Forest	Energy and Natural Resources
	Application of Remote Imagery to Habitat Classification	

Geochronology Services		Culture, Agriculture, Alberta Research Council, Energy and Natural Resources, Environment
Herbicides and Weed Management Research and Development	Performance Evaluation of Herbicides Crop Safety and Tolerance to Herbicides Behavior and Fate of Herbicides in Plants Behavior and Fate of Herbicides in Soil Chemical Damage Diagnostic Techniques Environmental Factors and Performance of Herbicides Research Appraisal and Planning Toxicity Tests on PVC Membrane Lining	Agriculture, Environment
Humane Trapping	Program Development	Energy and Natural Resources, Agriculture, Fur Institute of Canada
Inhalation Toxicology	Inhalation Toxicology Systems Development Health Effects of Sulphur Gases	Workers Health, Safety and Compensation, Agriculture, Environment
Insect Pest Management Research and Development	Special Crops Insect Pest Management Livestock Insect Pest Management	Agriculture
Lake Nutrients	Lake Nutrients	Environment
Microbiological Services	Microbiological Enumeration Services Microbiological Identification Services	Agriculture, Environment, Alberta Environmental Centre
Microbiological Processes in Waste Management	Survey of Feedlot Wastes Microbial Toxicity Services Microbial Metabolism of Toxicants Laboratory Manual for Toxicity Testing Using Microbial Systems	Agriculture, Environment, Alberta Environmental Centre
Native Species for Reclamation Research and Development	Native Species for Reclamation – East Slopes Native Species for Reclamation – Northern Alberta Native Species for Reclamation – Southern Alberta	Environment, Reclamation Research Technical Advisory Committee
Pest Management Diagnostic and Extension Services	Insect Diagnostic and Extension Services Plant Disease Diagnostic and Extension Services Weed and Chemical Damage Diagnostic and Extension Services	Agriculture, Energy and Natural Resources, Social Services and Community Health, Environment
Pesticide Analysis and Methods Development	Health Units Alberta Environment Pollution Control Division Alberta Environmental Centre Other	Social Services and Community Health, Energy and Natural Resources, Agriculture, Environment
Plant Pathology Research and Development	Disease Management in Cereals, Oilseeds, and Special Crops Disease Management in Forage Crops Disease Management in Woody Ornamentals, Shelterbelts and Turf	Agriculture, City of Edmonton
Potable Water Technology Research and Development	Treatability of Surface Waters Subject to Effluents from Pulp Mills Groundwater Treatment	Public Works, Supply and Services, Environment
Precipitation Studies	Precipitation Studies	Environment, Alberta Environmental Centre
Problem Wildlife	Diagnostic and Field Investigative Services Vertebrate Pest Management Chemical Control of Problem Wildlife	Energy and Natural Resources, Agriculture
Quality Control and Data Management	Quality Control and Data Management	Social Services and Community Health, Energy and Natural Resources, Agriculture, Environment, Alberta Environmental Centre, Private Laboratories
Soil Analytical Services	Soil Analytical Services Soil Mapping and Geostatistical Services	Reclamation Research Technical Advisory Committee, Environment, Alberta Environmental Centre

Soil Reclamation Research	Sodic Spoil Behaviour Brine Spill Reclamation Tailings Pond Stabilization	Agriculture, Energy and Natural Resources, Environment
Technology Development in Waste Management	Fixation of Wastes Evaluation of Fermentation Processes in Waste Treatment	Environment, Alberta Special Wastes Management Corporation
Thermal Conversion Processes	Development of Incineration Research Systems Hospital Wastes Incineration Oilfield Wastes Incineration	Hospitals and Medical Care, Environment, Alberta Special Wastes Management Corporation
Toxicology Services	Toxicology Services Toxicology Information Services Genetic Toxicology Development Reproductive Toxicology Development In Vitro Toxicology Development	Agriculture, Energy and Natural Resources
Toxicology of Biocides		Agriculture, Energy and Natural Resources, Environment
Toxicology of Petrochemicals and Fossil Fuels	Program Development Polycyclic Aromatic Hydrocarbons in Fish Toxicity of Tar Sand Holding Pond Effluent	Agriculture, Energy and Natural Resources Environment
Trace Organic Analysis and Methods Development	Health Units Alberta Environment Pollution Control Division Alberta Environmental Centre Other	Social Services and Community Health Energy and Natural Resources, Environment Alberta Environmental Centre
Wastewater Technology Research and Development	Treatment of Pulp Mill Effluent for Colour, Taste and Odour Removal Sewage Lagoon Modelling	Environment
Water Analytical Services	Health Units Pollution Control Division Alberta Environmental Centre Others	Social Services and Community Health, Energy and Natural Resources, Parks and Recreation, Environment
Wildlife Biology Services	Wildlife Biology Services Moose Mortality Study	Energy and Natural Resources, Alberta Environmental Centre
Wildlife Productivity	Wildlife Nutrition Physiology and Morphology of Wildlife Animal – Range Relationships Kikino Game Ranch Pilot Project Utilization of Revegetated Forage by Elk Monitoring of Free-ranging Animals	Energy and Natural Resources, Agriculture

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Bill Soltys
Don Turchin

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Gerald Wheeler, M.Sc. (Alberta)
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Wildlife Society Professionalism Committee

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*Experimental work done elsewhere

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(Thousands of dollars)

	Manpower	Supplies & Services	Grants	Fixed Assets	Total
Program Support	1184	925	0	171	2280
Plant Sciences	1147	278	10	242	1677
Chemistry	1951	383	0	309	2643
Animal Sciences	1524	593	0	133	2250
Environmental Technology	1007	334	0	665	2006
TOTAL	6813	2513	10	1520	10856

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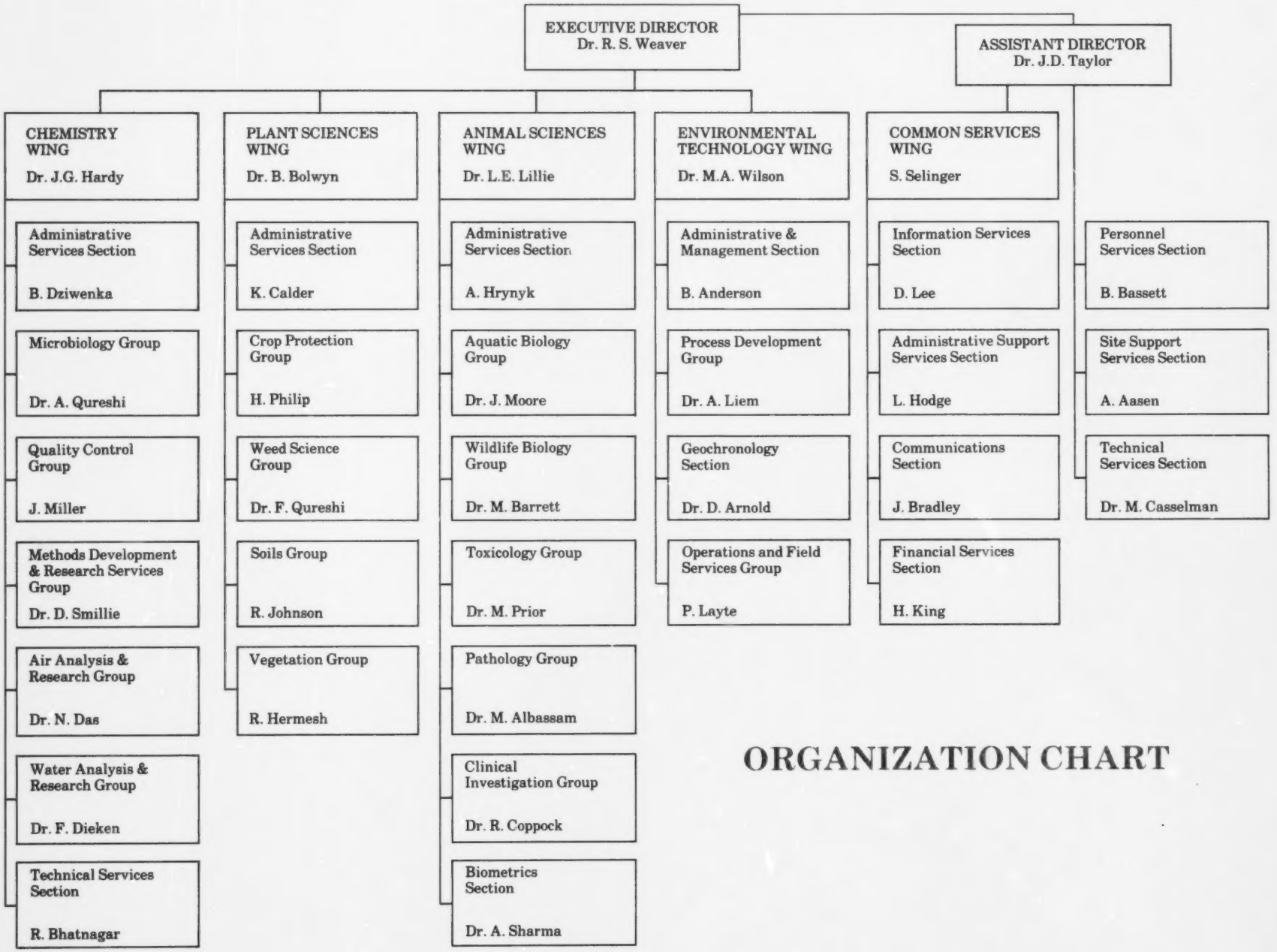

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